

Germany.

507.73
5

Philadelphia

INTERNATIONAL EXHIBITION,

Philadelphia, 1876.

1876
Phila
34
MHT

Machinery Hall—Sec. B, Columns 3 and 5.

CAST-STEEL WORKS

OF

FRIED. KRUPP,

Essen, Germany.

REPRESENTED BY

THOMAS PROSSER & SON.

✓ 675
AMERICAN OFFICE,

15 GOLD STREET,

NEW YORK.

1

3295-



ALBERTYPE

E. SIBERTALL, N. Y.

International Exhibition, Philadelphia, 1876.
Cast-Steel Works of FRIED. KRUPP, Essen, Germany.



ALBERTYPE

E. BIERSTATT, N. Y.

International Exhibition, Philadelphia, 1876.
Cast-Steel Works of FRIED. KRUPP, Essen, Germany.

TS

320

I62

1876

CHXRF

International Exhibition
(1876 : Philadelphia, Pa.)

~~507.73~~
E

Philadelphia Exhibition

1876.

CAST-STEEL MANUFACTORY

OF

FRIED. KRUPP,

NEAR

Essen, Germany.



NEW YORK:
E. P. COBY & Co., PRINTERS AND STATIONERS,
No. 95 William Street.

1876.

Representatives of the Firm :

- NEW-YORK**, MESSRS. THOMAS PROSSER & SON, 15 GOLD STREET.
Amsterdam, Messrs. Merrem & La Porte.
Berlin, Mr. Carl Meyer, Regentenstrasse 10.
Breslau, Mr. F. W. Gehra, Flurstrasse 7.
Brussels, Messrs. Morel & Co., 56 Rue du Marteau.
Cairo, Mr. S. Katzenstein.
Constantinople, Mr. O. Dingler.
Copenhagen, Mr. J. Bernburg.
Dresden, Mr. F. W. Gehra, Hohestrasse 5.
Florence, 8 via nazionale, Mr. François Porra.
Havana, Messrs. F. C. Schmidt & Co., Calle San Ignacio 66.
Hanover, Mr. O. Ehlers.
Hongkong & Shanghai, Mr. F. Peil ; Office at **Cologne**: Mauritius-
steinweg 2a.
Königsberg, i/Pr., Messrs. Steinfurth & Grothe.
London, Mr. Alfred Longsdon, (Fried. Krupp), 2 Crown Buildings Queen,
Victoria Street E. C.
Madrid, 4 Calle de la Biblioteca, Mr. C. C. Danelle.
Mayence, Mr. Adolph Vogel.
Munich, Mr. A. W. Pauli, Hessestrasse 14/II.
Paris, Mr. Henri Haass, 65 Rue de Provence.
St. Petersburg, Messrs. C. Wachter & Co
Santiago (Chili), Mr. Gust. Heyermann.
Stettin, Mr. Rod. Grunow.
Stockholm, Messrs. And. Berg & Co.
Strasburg, Mr. C. Wassmuth.
Varsaw, Mr. H. Somya.
Vienna, Mr. M. Muller, I Getreidemarkt 14.
Yedo, Yokohama & Hiogo, Messrs. H. Ahrens & Co. ;
Office at **London**: 17 Leadenhall Street,
Zurick, Mr. F. Lamarche, Oberdorgasse 17.

STATISTICAL DATA
OF THE
CAST-STEEL MANUFACTORY
OF
FRIED. KRUPP,
Near Essen,

Including the Mines and Blast Furnaces appertaining thereto.

The **Cast-Steel Manufactory** near **Essen** was established in the year 1810. It was conducted by Alfred Krupp from the year 1826, and taken by him on his own account in 1848. At the present time (April, 1876), the number of Workmen employed amounts to 10,500. The Works have been gradually developed, until they cover a continuous area of about 1,000 acres, of which about 200 acres are under roof.

In the Mines and Blast Furnaces, belonging to the Firm, there are employed a further number of about 5,000 Workmen.

The Articles manufactured are; **Axles, Tires, Wheels** and **Crossings** for Railways; **Rails** and **Springs** for Railways and Mines; **Shafts** for Steamers; different **Pieces of Machinery, Boiler Plates, Rolls, Spring-Steel, Tool-Steel, Guns, Gun-Carriages, Shot,** etc.

There are now in operation:

- 250 Smelting Furnaces,
- 390 Annealing Furnaces,
- 161 Heating Furnaces,
- 115 Welding and Puddling Furnaces,
- 33 Cupola and Reverberatory Furnaces,

160 Furnaces of other kinds.
 275 Coke Ovens.
 264 Smith's Forges.
 298 Steam Boilers.

77 **Steam Hammers** viz:

| | | | | | | | | |
|-------------|-----|-----|-----|-----|-----|------|-----|----|
| Number | 2 | 1 | 2 | 5 | 2 | 7 | 2 | 4 |
| (each) cwt. | 2 | 3 | 4 | 6 | 7 | 8 | 10 | 12 |
| Number | 7 | 8 | 14 | 3 | 1 | 7 | 3 | |
| (each) cwt. | 15 | 20 | 30 | 60 | 65 | 70 | 100 | |
| Number | 4 | 1 | 1 | 1 | 1 | 1 | 1 | |
| (each) cwt. | 110 | 140 | 150 | 200 | 400 | 1000 | | |

18 **Rolling Trains.**

294 **Steam Engines** viz:

| | | | | | | | | | |
|--------------|----|-----|-----|-----|-----|-----|-----|------|----|
| Number | 3 | 57 | 46 | 18 | 19 | 6 | 1 | 4 | 38 |
| (each) H. P. | 2 | 4 | 6 | 8 | 10 | 12 | 13 | 14 | 16 |
| Number | 4 | 21 | 16 | 3 | 23 | 7 | 2 | 4 | 4 |
| (each) H. P. | 18 | 20 | 23 | 25 | 30 | 35 | 40 | 45 | 60 |
| Number | 2 | 3 | 1 | 5 | 1 | 1 | 3 | 2 | |
| (each) H. P. | 80 | 100 | 120 | 150 | 200 | 500 | 800 | 1000 | |

representing altogether nearly 11,000 H. P.

1063 **Machine-Tools** viz:

365 Turning Lathes.
 82 Shaping Machines.
 199 Boring Machines.
 107 Planing Machines.
 42 Punching and Grooving Machines.
 32 Pressing Machines.
 63 Grinding Machines.
 31 Glazing and Polishing Machines.
 142 Machines of different kinds.

In the year 1875 there were consumed:

Coals and Coke 612,000 tons.

Water one thousand million gallons, supplied from several Water Works.

The Water-Conduit is fitted with 288 Hydrants and 438 Valves.

Gas two hundred and forty-six million cubic feet, supplied by the Gasworks of the Establishment, for 20,432 burners.

The Works are in Railway Connection with the "Cologne-Minden," "Bergisch-Märkisch," and "Rhenish" Lines.

To facilitate the Traffic in the Works there are :

- a. 24 Miles of Railway of **usual Gauge** with 201 Sidings and 35 Turntables on which run 14 Tank Locomotives of 15 inch Diameter Cylinder, and 537 Cars.
- b. 11 Miles of **Narrow Gauge** Railway of 31 inch Gauge with 263 Sidings and 46 Turntables, on which run

| | | | | | |
|---|----------------|------|--------|----------|-----------|
| 3 | Locomotives of | 6.18 | inches | diameter | Cylinder. |
| 4 | " | 6.69 | " | " | " |
| 3 | " | 7.87 | " | " | " |

 and 210 Cars.

The **Carriage-Department** comprises 214 Wagons and 80 Horses.

To facilitate the communication between the several Workshops there are 31 **Telegraph-Stations** with 45 Morse-apparatus, and 13 Stations with Inductors for the Railway-traffic. The Telegraph lines have a length of 37 miles.

A permanent **Fire-Brigade** consisting of 63 men with 8 fire-engines has also been instituted, who perform at the same time Police duty, and are lodged in the Barracks belonging to this Department.

The Firm has organized also a **Chemical Laboratory**, a **Photographic** and a **Lithographic Atelier**, as well as a **Printing** and **Bookbinding Establishment**. In the Printing Office there are 2 Steam and 4 Hand-Presses in operation.

The **General Supply Stores**, under control of the Firm, supply to voluntary purchasers (i. e. those belonging to the Works) for ready cash, Provisions, Clothing, Drapery, Boots, etc. at cost prices. The receipts of the different stores amount at present to about 270,000 Marks (\$67,500) monthly.

Under this head may also be named : 1 Hotel, 3 Beerhouses, 1 Selterswater Manufactory, 1 Flour Mill, 1 Bakery, with 2 Steam Engines, and 1 Slaughterhouse. The Bakery produces monthly about 431,000 lbs. Rye and Wheaten bread.

Of the **Dwellings** for the **Officers** and **Workmen** there are inhabited 3,277. At the present time there are living in these houses 16,200 Individuals. In the dwellings on the Mines and Smelting Works, belonging to the Firm, there are living 3,200 Individuals. The existing **Boarding-Houses** offer board and lodging to 2,500 unmarried workmen.

The Arrangements for the accommodation of the sick, consist of 1 **Hospital** containing 100 beds, and 1 **Epidemic-Hospital** with 120 beds, all under the supervision of Physicians especially engaged for the purpose.

There may be mentioned also a Bathing-Establishment with water and steam-baths and 1 Disinfecter, the latter for the purpose of disinfecting by Steam the beds and clothes of the sick.

A **Sick-Burial** and **Pension-Fund** has also been instituted for all the Workmen who receive wages from the Firm. The latter contributes to this Fund half the amount of the contributions paid in by the members, being in addition at the expense of providing pensions and support for those who have been rendered unfit for work in their service, and for the Widows of their workmen. The total receipts in the year 1875 amounted to 371,692 Mark (\$92,923), the expenditure to 319,226 Mark (\$79,806), and the Capital in hand at the beginning of the present year 694,016 Mark (\$173,504).

From another Fund members receive for their families free medical treatment against an annual payment of 4 Mark (\$1).

There is also instituted a society for Life Insurance.

Finally the Firm has organized and assists 4 Primary Schools with 21 classes, whilst 4 Industrial Schools for Girls and Women have been organized and are entirely maintained by the Firm. Besides the Firm bestows its particular interest upon several Schools for continuing education.

Besides the Cast-Steel Works near Essen, the Firm Fried. Krupp possesses considerable **Mining** and **Smelting-Works** which render same independent of fluctuations in prices, and secure to it a regular and uniform supply of the best raw material. This Department comprises :

1. Administration of Krupp's Mines:

a. **Coal Pits:**

1. Pit "Graf Beust,"
 2. " "Ernestine,"
 3. " "Friedrich Ernestine,"
 4. " "Hannover,"
- as well as one-third in the Concessions "Humboldt and Diergardt," on the left bank of the Rhine.

b. **Iron Ore Mines:**

1. In the Mining Districts "Kirchen," "Daaden," "Siegburg," "Hamm," "Neuwied," together 64 Mines (No. 1 to 64);
2. In the Mining Districts "Wetzlar," "Weilburg," "Dietz," "Oberhessen," "Rheinhessen" and "Dillenburg," together 294 Mines (No. 65 to 358);
3. In the Mining Districts "Hamm a. d. Sieg," "Wied," "Unkel," "Coblenz," "Ründeroth," together 56 Mines (No. 359 to 414).

Total number of Mines 414, with an area of about 50,000 acres.

The Firm Fried. Krupp possesses finally important Concessions of excellent Iron Ore Beds in North Spain.

2. The Administration of Krupp's Smelting-Works comprises:

- a. The **Sayner and Oberhammer Smelting Works**, containing 2 Blast Furnaces, one of them fed with Charcoal, producing "Spiegeleisen" and "Charcoal Spiegeleisen." An Iron Foundry and a Machine Manufactory are connected with the "Sayner" Works.
- b. The **Mülhofer Smelting Works** on the Rhine, connected by a branch line with the Rhenish Railway, terminating at the Engers Station and containing 4 Blast Furnaces (3 of them of the latest Scotch construction) with Pneumatic Lifts, producing Spiegel, Bessemer and Fine-Iron.

- c. The **Hermanns Smelting Works** on the Rhine near Neuwied, also connected by a branch line with the Rhenish Railway, with 3 Blast Furnaces producing Spiegel, Bessemer and Fine-Iron.
- d. The **Bendorf Smelting Works** with 1 Blast Furnace of an older pattern.
- e. The **Johannes Smelting Works** near Duisburg on the Rhine has 4 Blast Furnaces, producing Spiegel, Bessemer and Fine-Iron. The Works are in connection with the "Rhenish" and the "Bergisch-Märkisch" Railway. These Works have also 140 Coke Ovens in operation.

The Coals destined for Coke are especially washed by washing-machines.

Besides the Proof-Butts at the Establishment at Essen, where all Guns and Carriages are tested, the Firm Fried. Krupp has also an extensive Range near Dulmen, in Westphalia, for ballistical trials, etc. This Range has a length of $4\frac{2}{3}$ miles, so that trials for any required distance can be made.

The transport of the Ordnance-material from the Establishment at Essen to the Range is effected by Railway.

To facilitate the Ocean transportation of Ore and large masses of Metal, such as heavy Ordnance, etc., for which ordinary vessels are not suitable, the Firm has constructed a fleet of 4 **Iron Steam-Ships**, of 1700 tons capacity each. One of these, the "**Essen**," was employed to convey the following, and other goods, from Bremen to Philadelphia, for the Centennial Exhibition, arriving at the latter Port, April 23d, 1876.

Catalogue and Description of the Objects for Exhibition.

1. 1 **Shaft** with 3 **Cranks** and **Coupling flange**, in the **forged** state, for a 2500 H. P. engine of an Iron-Clad now in construction for the Imperial German Navy.

Weight $13\frac{1}{2}$ Tons.

This Shaft is forged under a Steam-Hammer of 50 tons weight from a solid cylindrical Block of Crucible Cast-Steel of 30 tons weight and of 56 inches diameter.

2. 1 **double Crank Shaft** with **coupling flange** of Crucible Cast-Steel, also forged from a solid Block and finished for a Transatlantic Steamer.

Weight 9 Tons.

3. 1 **Locomotive straight Axle** of Crucible Cast-Steel in the forged state (Pattern of the North Eastern Railway in Switzerland).

4. 1 forged **Tender Axle** of Crucible Cast-Steel (Pattern of the same Railway). The body of this axle is forged complete under the hammer, and requires no further workmanship.

5. 1 **Car Axle** of Crucible Cast-Steel forged according to the dimensions approved by the German Railways. The body is, in the same manner, forged complete under the hammer.

6. 2 **Piston Rods** forged from Crucible Cast-Steel.

7. 1 **Coupling Rod** forged from Crucible Cast-Steel.

8. 2 **Slide Bars** forged from Crucible Cast-Steel.

9. 1 **Piston** forged from Crucible Cast-Steel (Pattern of the Niederschlesisch-Märkisch Railway).

10. 1 **Axle Box** for Locomotives.

1 **Cylindrical Flange** for Gun-Carriages.

- 1 **Crank-piece** with 2 spokes for Locomotive-wheels.
 1 “ “ 3 “ “ “

These objects have been made of Wrought-Iron under a Haswell-Hydraulic-Press of 800 tons pressing-power.

11. 4 **Tires** of Crucible Cast-Steel in the rolled state, viz:

- 1 of $56\frac{1}{4}$ inches inside diameter,
 1 of $18\frac{1}{2}$ “ “ “
 1 of 26 “ “ “

the latter 2 being intended for Paper-wheels.

1 **Tire** of Crucible Cast-Steel, turned and bored, of $94\frac{1}{4}$ inches inside diameter.

These Tires have been forged from solid Blocks of Crucible Cast-Steel by making a cut in the middle and driving them out under a hammer. Then the Tires have been rolled to the different diameters and sections.

Up to the year 1853 were principally used only Wrought-Iron and Fine-grain Tires. The Establishment Krupp was the first to introduce solid Cast-Steel Tires for Railway purposes, and these have since become of ordinary and extensive use.

12. 1 **Angle Ring** of Crucible Cast-Steel for Steam Boilers made in the same manner as the Tires.
13. 1 **Car Axle** of Crucible Cast-Steel in the finished state according to the dimensions approved by the German Railways.
14. 1 **Locomotive Leading Axle** of Crucible Cast-Steel in the finished state (Pattern of the North Eastern Railway in Switzerland).
15. 1 **Locomotive Crank Axle** of Crucible Cast-Steel in the finished state with double bearings.
16. 1 **Locomotive Eccentric Crank** and 1 **Driving-Wheel Crank**, both of Crucible Cast-Steel in the finished state.
17. 1 **Locomotive Driving Axle** of Crucible Cast-Steel ready fitted with Tires, Cranks of same material, Spoke Wheels, Nave and Counter weights included, of Wrought Iron.
 Weight 5,147 lbs.

18. 1 **Tender-Axle** of Crucible Cast-Steel, body forged, ready fitted with Tires of same material and Spoke Wheels, Nave included, of Wrought-Iron.

Weight 2,564 lbs.

19. 1 **Car Axle** of Crucible Cast-Steel, body forged, ready fitted with Tires of same material and Spoke Wheels, Nave included, of Wrought-Iron.

Weight 2,088 lbs.

20. 1 **Car Axle** of Crucible Cast-Steel, ready fitted with **Disc Wheels cast in moulds**, of same material.

Weight 2,210 lbs.

The annexed piece cut off from such a Disc wheel shows the solid and sound casting.

21. 1 **Car Axle** of Crucible Cast-Steel, ready fitted with Tires of same material. The Wheels being constructed of **Pressed** plates of Crucible Cast-Steel, Nave, Hoops, Bolts and Screws of Wrought-Iron.

This class of Wheels have, besides great elasticity, the advantage, that the tire is fastened on its whole circumference and that it cannot become loose even in case of breakage. Trials made have given very favorable results.

The construction of these Wheels has been patented in the United States of America and in Canada, by the Firm Fried. Krupp.

22. 2 **Wheels** of Wrought-Iron, the one in the forged, the other in the finished state.

These Wheels are made by coiling a Wrought-Iron-Band of different widths, the one width forming the nave, the other the disc and the last the rim of the wheel. The Coil is then welded together.

This method of making Wheels is patented by the Firm Fried. Krupp in the United States of America and Canada.

23. A collection of Fractures of Spring Steel and of Sections of Spring Steel bars. The Spring Steel is supplied in bars of any section not below $\frac{1}{5}$ of an inch thick, and 1 inch wide.

24. A collection of **Cast-Steel Springs** for Locomotives, Tenders and Cars.
- a. 2 Locomotive Springs with 10 flat leaves, welded Links and bored Bolt-holes.
 - 2 of the same with 14 flat leaves and welded, bored and fraised Bolt-holes.
 - b. 2 Collision Springs with 9 flat leaves.
 - 1 do. do. with 13 ribbed leaves.
 - c. 1 Tender Spring with 9 flat leaves.
 - d. 1 Passenger Car Spring with 5 ribbed leaves and rolled eyes.
 - 1 of the same with 6 flat leaves and rolled eyes.
 - 1 do. do. 7 do. and welded eyes.
 - e. 1 Freight Car Spring with 5 flat leaves and rolled eyes.
 - 1 do. do. do. 6 ribbed leaves and rolled eyes.
 - 4 do. do. do. 7 do. do. do.
 - 4 do. do. do. 8 flat do. do.
 - f. 3 Buffer Springs.
25. 1 **reversible Double Crossing** of Crucible Cast-Steel cast in a mould and ready to be laid down. (Pattern of the Cologne Minden Railway).
26. 1 **Bessemer Steel Rail**, 55 ft. in length, four times bent. Section of the Ribinsk Bologoie Railway in Russia. The one end of the Rail shows the fracture, the other end the section. Weight 1,061 lbs.
27. A collection **Bessemer Steel Rail-Fractures** of different sections.
28. 1 **Switch** of Bessemer Steel ready planed, the one end forged out to the Vignol section. (Pattern of the Berlin-Stettin Railway.)
29. 1 **Rolling Mill** A $2\frac{1}{2} \times 1\frac{1}{2}$ inches.
 - 1 do. B 3×2 do.
 - 1 do. C 6×4 do. polished.
30. 1 **Roll** of 24 inches diameter and $21\frac{2}{3}$ inches length of face. All Rolls of Crucible Cast-Steel and hardened.

31. A Collection of **Cast-Steel Wheels** for **Mining Cars**, adopted by the Mines in the Rhenish Westphalian Coal-District on account of their lighter weight and greater resistance in comparison with Chilled Iron-Wheels.
32. 1 **Boiler-Plate** of Wrought Iron cut to 23 ft. 6 in. length, 6 ft. 2 in width, and $\frac{3}{8}$ in. thick. *Ref*
33. 1 **Boiler-Plate** of Crucible Cast-Steel, untrimmed. Greatest length, 29 ft. 11 in.: width, 5 ft. 6 in.: thickness, $\frac{3}{8}$ in. *Ref*
34. 2 pressed **Sides** for Field-Gun-Carriages, of Cast-Steel, $\frac{3}{8}$ in. thick.
2 of the same $\frac{1}{4}$ in. thick.
35. 2 pressed **Bearing-Beams** for Ammunition-Wagons, of Cast-Steel, $\frac{1}{4}$ in. thick.
36. A collection of Fractures of hardened Tool and File-Steel, as well as various other Fractures of manufactured Articles, such as Axles, Tires, Crossings, Disc-Wheels, Piston Rods, Shearknives and Angle-Rings. Also Mint-Dies, with polished surfaces.
37. A series of various classes of Ore, Pig Iron and Pig Steel-Iron from the Mines and Blast Furnaces of the Firm, used in the manufacture of Steel. *ET*

Artillery Material.

The Guns are Manufactured from Crucible Cast-Steel, of a quality especially adapted for the purpose.

38. 14 inch Gun on Coast-Carriage.

| | |
|------------------------------------|------------------------|
| Calibre | 14 inches. |
| Length of Gun | 315 " |
| Length of Bore | 270 " |
| Weight of Gun with wedge | 57 $\frac{1}{2}$ Tons. |
| Preponderance | 0. |

The Gun has 80 parallel grooves with $\frac{1}{8}$ inch width of Lands and a uniform twist of 630 inches in length.

| | |
|--|------------|
| Weight of charged Steel Shell | 1,127 lbs. |
| do. Chilled-Iron Shell | 1,160 " |
| do. Common Shell with Fuse | 906 " |
| Weight of charge (Prism. Powder) for Steel and Chilled-Iron Shell | 276 " |
| The same for Common Shell with Fuse | 243 " |
| Initial velocity of Steel Shell | 1,590 ft. |
| do. of Chilled-Iron Shell | 1,568 " |
| do. of Common Shell | 1,624 " |

The Carriage is intended for Earth Parapets of $6\frac{1}{2}$ ft. height, and has a height of $8\frac{3}{4}$ ft. To check the recoil, Hydraulic Buffer with 2 Cylinders is used. The running-out of the Gun after discharge is self-acting.

The projectile is lifted by means of a moveable Crane, which is arranged on the right-hand side of the Slide.

The elevation ($+ 18\frac{3}{4}$ and $- 7^\circ$) is effected by means of a Toothed Elevating arc on the upper part of the Carriage. For training the Gun the end of the Slide is provided with a Chain-gear. Elevating and training machines are fitted with pointer-apparatus.

To run-in the Gun, (this being however never required in using the Gun,) there are pulleys with strong ropes which can be worked by a Rope-Windlass placed on each side of the Slide behind.

By all these arrangements the gun can be very easily and quickly served, with proportionally few hands.

The Carriage is constructed preferably of wrought Iron.

The axles, Hydraulic cylinders and Slide-rollers are of Cast-Steel. Cast-Iron is used only for secondary parts.

| | |
|------------------------------|----------------------|
| Weight of Carriage | $9\frac{2}{3}$ Tons. |
| do. of Slide | $24\frac{1}{8}$ " |
| Total weight | <u>34 Tons.</u> |

39. Long $9\frac{1}{2}$ inch Gun on Coast-Carriage.

| | |
|--------------------------|------------------------|
| Calibre | $9\frac{1}{2}$ inches. |
| Length of Gun | 206 " |
| Length of Bore | $177\frac{1}{2}$ " |

| | |
|------------------------------------|------------------------|
| Weight of Gun with wedge | 15 $\frac{3}{4}$ Tons. |
| Preponderance | 0. |

The Gun has 54 parallel grooves with $\frac{1}{8}$ inch width of Lands and a uniform twist of 425 inches in length.

| | |
|--|-----------|
| Weight of charged Steel Shell | 343 lbs. |
| do. Chilled-Iron Shell | 356 " |
| do. Common Shell with Fuse | 276 " |
| Weight of charge (Prism. Powder) for Steel and Chilled-Iron Shell | 84 " |
| The same for Common Shell with Fuse | 73 " |
| Initial velocity of Steel Shell | 1,542 ft. |
| do. of Chilled-Iron Shell | 1,526 " |
| do. of Common Shell | 1,542 " |

The Gun is mounted on a Slide-Carriage for Earth Parapets of 5 $\frac{3}{4}$ ft. height. The Carriage has a height of 7 $\frac{3}{8}$ ft. and its construction is similar to that for the 14 inch gun, but all its parts are not so heavily constructed and more simple.

The limits for elevation are in maximum -|- 20 and — 6°.

The Gun has been subjected, on the end of last year, to a trial at the practice ground at Dulmen belonging to the Firm, in presence of a Committee of Officers of the Royal Dutch Artillery. The following Rounds have been fired :

| | | | | | | | |
|---|------|------------------|------|--------|----|--------|---------|
| 1 | with | 66 $\frac{1}{4}$ | lbs. | charge | of | Prism. | Powder, |
| 4 | " | 70 $\frac{3}{4}$ | " | " | " | " | " |
| 113 | " | 73 | " | " | " | " | " |
| 1 | " | 75 | " | " | " | " | " |
| 1 | " | 77 $\frac{1}{4}$ | " | " | " | " | " |
| 1 | " | 84 | " | " | " | " | " |
| and Common Shells of 276 $\frac{1}{4}$ lbs. weight, | | | | | | | |

also

| | | | | | | | |
|---|------|------------------|------|--------|----|--------|---------|
| 1 | with | 55 $\frac{1}{4}$ | lbs. | charge | of | Prism. | Powder, |
| 1 | " | 62 | " | " | " | " | " |
| 1 | " | 66 $\frac{1}{4}$ | " | " | " | " | " |
| 1 | " | 70 $\frac{3}{4}$ | " | " | " | " | " |
| 3 | " | 73 | " | " | " | " | " |
| 4 | " | 77 $\frac{1}{4}$ | " | " | " | " | " |
| 1 | " | 79 $\frac{1}{2}$ | " | " | " | " | " |

118 with 84 lbs. charge of Prism. Powder.
 2 " 88½ " " " " "
 and chilled-Iron-Shells of 338 to 356 lbs. weight.

40. 3½ inch Field-Gun with Carriage.

| | |
|--|------------------------|
| Calibre | 3½ inches. |
| Length of Gun | 82½ " |
| Length of Bore | 73¾ " |
| Weight of Gun with wedge | 1,072 lbs. |
| Preponderance on the breech-face | 102 " |
| The Gun has 24 Parallel grooves. | |
| Width of grooves | $\frac{3}{16}$ inches. |
| Width of Lands | $\frac{1}{9}$ " |
| The twist is uniform and has a length of 45 calibres = 157 " | |
| Length of line of sight | 39½ " |
| Weight of charged Shell | 13¾ lbs. |
| do. of exploding charge | $\frac{1}{2}$ " |
| do. of shrapnel-shot complete | 15¾ " |
| do. of exploding charge | $\frac{1}{5}$ " |
| do. of canister-shot | 13¾ " |
| do. of charge for gun (coarse-grain-powder) | $3\frac{3}{16}$ " |
| Initial velocity of Shell | 1,558 ft. |

The Carriage has pressed brackets and cross-joints of Cast-Steel-plates, axle of Cast-Steel, wood-wheels with Iron-tires and naves of bronze.

Weight of the Carriage (without Accessories) 1,127 lbs.
 Pressure of carriage-trail, with gun mounted
 and complete Accessories, on the ground 232 "

The Elevating Screw admits of 24° elevation and 8° inclination.

The height is 43¾ inches.

The Limber is, excepting wheels and pole, constructed of Iron and arranged to take

20 Shells
 10 Shrapnel-Shot
 2 Canister-Shot

in all 32 projectiles.

| | | |
|--|-------|------|
| Weight of empty Limber | 1,105 | lbs. |
| do. of Accessories for Limber | 155 | " |
| do. of Ammunition | 575 | " |
| do. of Limber with all Accessories | 1,834 | " |
| do. of Gun, unloaded | 3,260 | " |
| do. of complete Accessories and Ammunition | 774 | " |
| do. of Gun, complete with Accessories | 4,033 | " |
| Turning-angle | 175° | |
| Charge upon leading-axle | 1,978 | " |
| Charge upon trailing-axle | 2,055 | " |
| Draught-Charge per Horse | 672 | " |

41. 3 inch Field-Gun with Carriage.

| | | |
|--|------------------|---------|
| Calibre | 3 | inches. |
| Length of Gun, | 78 $\frac{3}{4}$ | " |
| Length of Bore, | 70 $\frac{2}{3}$ | " |
| Weight of Gun with wedge, | 663 | lbs. |
| Preponderance on the breech-face, | 96 | " |
| The Gun has 24 Parallel Grooves. | | |
| Width of Grooves, | $\frac{1}{4}$ | inch. |
| Width of Lands, | $\frac{1}{9}$ | " |
| The Twist is uniform and has a length of 45 calibres = 135 " | | |
| Length of line of sight, | 35 $\frac{1}{2}$ | " |
| Weight of charged Shell, | 9 $\frac{1}{4}$ | lbs. |
| do. of exploding charge | $\frac{3}{10}$ | " |
| do. of Shrapnel-Shot complete | 9 $\frac{1}{2}$ | " |
| do. of exploding charge | $\frac{1}{3}$ | " |
| do. of Canister-Shot | 8 $\frac{3}{4}$ | " |
| do. of charge for gun (coarse-grain-powder) | 2 $\frac{1}{2}$ | " |
| Initial velocity of Shell | 1,500 | ft. |

The Carriage is constructed also of pressed brackets with cross-joints of Cast-Steel-Plates, axle of Cast-Steel and wheels similar to those of the 3 $\frac{1}{2}$ inch gun-carriage.

The weight of the carriage (without Accessories) is 1,017 lbs.

Pressure of carriage-trail, with gun mounted and complete Accessories, on the ground 225 lbs.

The Elevating Screw admits of 25° elevation and 8° inclination.

The Height is 43 inches.

The Limber is of the same construction as that for the $3\frac{1}{2}$ inch gun, and arranged to take

24 Shells
12 Shrapnel-Shot
2 Canister-Shot

in all 38 projectiles.

| | | |
|---|----------------|------|
| Weight of empty Limber | 1,017 | lbs. |
| do. of Accessories for Limber | 144 | " |
| do. of Ammunition | 453 | " |
| do. of Limber with all Accessories | 1,613 | " |
| do. of Gun, unloaded | 2,667 | " |
| do. of complete Accessories and Am- munition | 625 | " |
| do. of Gun complete | 3,203 | " |
| Turning-angle | 178 $^{\circ}$ | |
| Charge upon leading-axle | 1,750 | " |
| Charge upon trailing-axle | 1,543 | " |
| Draught-Charge per Horse | 548 | " |

42. 3.15 inch Mountain-Gun with Carriage.

| | | |
|---|------------------|-------|
| Calibre | 3.15 | inch. |
| Length of Gun, | 38 $\frac{3}{8}$ | " |
| Length of Bore, | 33 $\frac{1}{4}$ | " |
| Weight of Gun with wedge, | 228 | lbs. |
| Preponderance on the breech-face, | 50 | " |

The Gun has 18 Parallel Grooves with $\frac{1}{8}$ inch width of Lands, and 118 inches length of twist.

| | | |
|------------------------------------|-----------------|------|
| Weight of charged Shell, | 8 $\frac{3}{8}$ | lbs. |
| do. of exploding charge | $\frac{3}{15}$ | " |
| do. of charge for gun | $\frac{7}{8}$ | " |
| Initial velocity | 950 | ft. |

The Carriage has pressed brackets with cross-joints of Cast-Steel, axle of Cast-Steel and wheels of same construction as that for the Field-Gun Carriage.

Weight of Carriage with wheels 323 lbs.

The Elevating Screw admits of 18° elevation and 10° inclination.

The Height is $23\frac{1}{2}$ inches.

Weight of Pole 24 lbs.

The Ammunition-Boxes are constructed of wood with Iron-Bands.

Each Box contains 8 Shot, viz: 6 Shells and 2 Canister Shot, with the necessary Cartridges placed in 2 Cartridge Boxes, Fuses and the necessary Accessories.

| | |
|---------------------------------------|---------|
| Weight of empty Box | 21 lbs. |
| do. of Box with Accessories | 104 " |

43. 2.36 inch Mountain-Gun with Carriage.

| | |
|--|-------------------|
| Calibre | 2.36 inch. |
| Length of Gun | $39\frac{1}{2}$ " |
| Length of Bore | $34\frac{2}{3}$ " |
| Weight of Gun with wedge | 199 lbs. |
| Preponderance on the breech-face | 35 " |

The Gun has 18 Parallel grooves with $\frac{1}{8}$ inch width of Lands and 83 inches length of twist.

| | |
|-----------------------------------|---------------------|
| Weight of charged Shell | $4\frac{1}{2}$ lbs. |
| do. of exploding charge | $\frac{1}{5}$ " |
| do. of charge for gun | $\frac{1}{2}$ " |
| Initial velocity | 920 ft. |

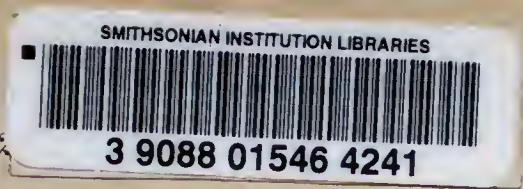
The Carriage has pressed Brackets and Cross-joints of Cast-Steel-Plates, axle of Cast-Steel and wheels of same construction as that for the Field-Gun Carriage.

Weight of Limber with wheels but without Accessories 179 lbs.

The Elevating Screw admits of 20° elevation and 10° inclination.

The Height is $24\frac{1}{4}$ inches.

Weight of Pole, belonging to the Limber 24 lbs.



The Ammunition-Boxes have the same construction as for the 3.15 inch Mountain-Guns.

Each Box contains 16 Shot, viz: 14 Shells, 2 Canister Shot, with the necessary Cartridges placed in 2 Cartridge Boxes, Fuses and the necessary Accessories.

| | | |
|---------------------------------|-----------|---------|
| Weight of empty Box | | 22 lbs. |
| do. of Box with all Accessories | | 106 " |

44. Saddles and Harness for 2.36 in. Mountain Guns.

The Saddle for carrying the Gun is intended for the transport of the Gun, and it is fastened upon same in the cross-direction.

Weight of Saddle with complete Harness 46 lbs.

The Saddle for carrying the Limber is intended for the Limber with wheels, Accessories and Pole.

The Carriage is fastened upon the Saddle in the longitudinal direction.

Weight of Saddle with complete Harness, 48 lbs.

The Harness for Gun and Limber-Saddle is so arranged that the draught-animals can be put to the pole.

The Saddle for taking up Ammunition is intended for the transport of 2 Ammunition-Boxes with in all 32 shot.

Weight of Saddle with complete Harness 38 lbs.

45. 3½ inch Gun on Carriage completely polished.

Construction same as described under No. 40.

+

46. A collection of Shot.